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Edward S. Wilson.

Edward S. Wilson.

A Study

OF

Various Sources of Sugar.

Sugar-cane, Sorghums, Sugar Beet,
Maple, Watermelons, etc.

BY
LEWIS S. WARE,
MEMBER OF AMERICAN CHEMICAL SOCIETY, ETC.

PRICE, FIFTY CENTS.

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To Dr. George B. Loring,

Commissioner of Agriculture, Washington, D. C.

Dear Sir: In inviting your attention to the following pages, in which the undersigned has attempted to examine into the various sources of the supply of sugar, and especially of those which are, or have been, deemed available for this country, no apology is thought necessary. The overwhelming importance of the subject is such that it cannot be ignored by the American people, even if they would. Politically independent for more than a century, the United States has thus far been unable to achieve its industrial and financial independence. The result has been a visitation of almost periodic monetary crises, accompanied each time by a paralysis of industries largely arising from the great indebtedness of our people to Europe. The outlook at the present moment is such as to indicate that the fruits of the protective policy which we have enjoyed for two decades, may be such as to bring at an early day our entire emancipation from this thraldom.

The undersigned, therefore, respectfully begs leave to suggest that sugar, being the largest single

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article of import into this country, offers a greater field for usefulness in the investigation and the introduction and development of a new industry, and the accomplishment of this great national aim, than any not now here existing. That of beet-sugar, after years of patient investigation, he believes to be entirely feasible; others which have been attempted, he is equally certain must fail. It could not but be a source of satisfaction to yourself during the remainder of your life to feel that you, as the head of the Department of Agriculture, had been largely instrumental in the introduction of this new industry, so vital to the real independence of your country. He therefore begs leave to express the hope that your administration will be signalized in our history as the one which has done most to bring about this great result.

Very respectfully your obedient servant,

LEWIS S. WARE.

Philadelphia, October 1, 1881.

PREFACE.

THE OBJECT OF THIS PAMPHLET is to call public attention to the importance of considering a plausible and practical cause, and not theories long since thrown aside in Europe. We refer to cornstalk and sorghum utilization, and the impracticability of their ever supplying the home demand with sugar.

It would be absurd to suppose that the sugar cane, when to be used for sugar manufacture, can be grown at the North, and it is equally ridiculous to imagine that a sub-variety could be there grown, as experiments have long since proven that the farther north these high breeds are planted the less sugar they contain. This, as one might suppose, would be sufficient to condemn the cultivation named; but, notwithstanding, our Government has spent two years of its time and money upon a series of investigations that have proved absolutely nothing, for the reasons that sugar in no practical amount has ever been produced, and the small quantity obtained was the result of several months' crystallization. This last fact should have been sufficient to condemn further investigations. The greater number of samples selected at Washington were grown under favorable circumstances, and the results obtained should not be compared with those that might have resulted from canes grown by the novice in the Northern and New England States. (What we have just said regarding the sorghum might be repeated in reference to the early amber cane.) In all cases it should be remembered that the sub-

varieties must be worked, as admitted by all authorities, within twenty-four hours after cutting. Storage, consequently, becomes impossible. The time of manufacturing is reduced to comparatively small limits.

As for the possibilities of growing the sorghum, as many contend, from Texas to Maine, we fail to see the truth of the assertion. Attempts made to grow and utilize it in the Southern States were satisfactory, much more so than those in the North. But this, again, proves in a positive manner the fallacy of the supposed Northern sugar cane. We are convinced, however, that with a proper selection of seed, etc., its cultivation may be made compatible with the southern climate, which the sugar cane is not, as the heat required for its complete maturity is less than for the cane from which it originated. In regard to the sugar cane of the South, we would say that it is obtained from cuttings, and not as in the West Indies from early sprouts that come from the original plant after being once planted. But with the sorghum, on the other hand, the seeds are grown one year, and planted the next. Many argue that two crops may be obtained in a season. If this were practically true, the sorghum would be of immense advantage to the Southern sugar planters, but is worthless under all other circumstances. We have endeavored, in the following pages, to call attention to an acknowledged principle in sugar manufacture that is generally overlooked in the sorghum arguments. In conclusion we would say, that syrup may be made from many plants that are sweet, or contain combined with them any amount of saccharine substances; but this molasses or syrup does but little towards the supplying of the home demand with sugar. We know of no sorghum sugar being practically made by farmers in larger quantities than perhaps a few ounces at a time, and under remarkable

circumstances as to period of crystallization and percentage of juice utilized.

The sorghum reports and treatises are in many respects interesting. As a study of botany we find, for example, how the seed grows, how the sugar is formed, etc., but the most interesting of all is overlooked,—how the sugar is to be extracted. In theory, we are told how this may be done. Advice is given to follow closely sugar-cane methods, but no practical results are mentioned. In the subsequent pages we have considered every source, for example, watermelons, pumpkins, white and sweet potatoes, etc., and we are convinced that the sugar beet alone can supply the North with sugar, and it is the only profitable Northern sugar-yielding plant. We trust that our readers will realize this, and concentrate their efforts in the direction indicated.

SORGHUM SUGAR.

The Sugar from Sorghum—Its History, etc.

IN the prehistoric ages attempts were made to manufacture sugar from sorghum. In the histories of Egypt, Arabia, etc., mention is made of the Emphee and African types. Of these we have, first, the early Sorgo; second, the white Emphee (or the *Nee-a-za-na*), and on the other hand the black Emphee; also the red Emphee (or *Shla-goo-ra*) and the Liberian. Besides these we have no less than twenty or thirty other varieties. The name of sorgo was given in 1542, and mention is made of its having existed in the East Indies during the sixteenth and seventeenth centuries. Numerous essays were written by the botanists of that period regarding this plant and its varieties; and from the earliest day down to the present, various names have been given, as *Sorgo*, or *Chinese Sugar Cane*, *India Cane*, *Emphee*, or *Coffers' Bread*, *Pain-des Anges*, etc.

In 1850 Count Montigny sent the first samples of sorghum of a Chinese variety to Europe (that people having used it for thousands of years for the manufacture of a red dye), and exhibited it to the Geographical Society in Paris. Seeds were subsequently sold to Vilmorin & Co. at twenty cents each; and some of another variety were brought to this country by Leonard Wray, an English gentleman. The type he

introduced, however, was of an African origin, and to him is, in part, justly due the foolish experiments going on ever since. The seeds were distributed by the Patent Office. From the early introduction down to the present day numerous books and articles have been written on this subject; promises without number have been made, but we know of no case where these were fulfilled. The French feared that when it was first talked of it would compete with the sugar beet, but subsequent research proved there was no occasion for alarm. Experiments, however, in the southern part of Europe were, and are still, extremely promising; but the same cannot be said of the northern attempts; and it has been concluded that nothing is to be expected of sorghum north of Lisbon. The subject has long since been abandoned in France, and the only traces of it are for alcohol manufacture. It seems strange that we Americans were not willing to avail ourselves of what these people have done, but must continue nearly in the same paths, as we have been doing, with negative results, for more than thirty years. We would say that the name sorghum is a mere disguise, for the reason that it is nothing more nor less than a sub-variety of sugar cane, which may explain why it is that the reader and the investigator have so frequently been misled. In consequence of the continual crossing but two principal varieties remain, the Chinese and the African types.

Crystallization of Sorghum Sugar.

Will this sugar crystallize in a reasonable time? We can positively say that it will not, in consequence of the impurities the juices contain; a

well-acknowledged principle in sugar manufacture* being, that every equivalent of impurities, whatever it may be, will prevent an equal amount of crystals from forming.† Such, in reality, is one of the principles generally overlooked by those interested in sorghum sugar. Many contend that the sugar is there, and, consequently it may be extracted, but by what method we know not. On the other hand a well-known writer and chemist admits that these impurities are disadvantages to contend with, but when they are removed, the problem will be solved. But what solution is to be given to the chemico-mechanical difficulty is not stated. It is true that any sugar solution will in time crystallize; but if two, three or four months are required for it to take place, the

**It has long since been admitted that impurities including glucose will prevent four to five times their weight of sugar from crystallizing. In the Comptes Rendus de l'Academie des Sciences of 1873 we read a note by E. Monnier regarding the refining of crude sugar. He says: "To estimate the quantity of uncrystallized or inverted sugar that is produced in the operation of refining, it is sufficient to ascertain exactly the amount of salts or ash the molasses contains, and to multiply this by a proper coefficient varying from four to five." In reference to the above we would say: For years past in France the taxation of refined sugars has been estimated upon a basis that salts prevent the sugar from crystallizing to an amount equal to four or five times their weight. The crystallization will not take place when the sugar is four times that of the salts. No allowance has been made for the action of organic substances. Some salts crystallize simultaneously with the sugar, and become then even more objectionable than if they had simply a mechanical action.*

† The above is a mimimum limit.

working of the plant, as before stated, is not practical. Some sorghum sugar was exhibited at the Ohio State Fair, about five years ago, that required an entire year for its crystallization to become complete. We are informed, on the other hand, that upon several occasions samples of excellent "sorghum" sugar (as contended by the interested parties) have been exhibited, which were said to have been obtained from the sorghum plant, but were nothing more than second grades of cane-sugar. This evidently had the effect of misleading the public. In the Agricultural Report of 1877, page 235, a description is given of a certain process partly endorsed by our Government. It is said that the juice of any permanent variety of sorghum now known in the country may be rapidly and uniformly crystallized.

"It is claimed that ten pounds of sugar may be made from one gallon of dense syrup." This represents twice the amount admitted as possible by the growers throughout the country. Has this percentage of sugar by this new process ever been obtained? We can positively say that it has not, as it would be equal to the very best cane grown in the Southern States.

The same gentleman claims that he has discovered a body possessing the remarkable quality of "isolating the sugars of both kinds in a solution, sucrose and glucose, and protecting them as by an impenetrable shield against the action of the forces by which the other deleterious substances are either neutralized or destroyed." The defecation of the juice is no longer necessary. By this process, carbonic acid need not be used; the animal black, consequently, need be but in very small quantities. In other words, all the costly outlay existing in the cane and beet process are done away with. The sugar has nothing left in its way, and the crystalli-

zation is perfect. What could be more ridiculous and imaginary than the above? But, notwithstanding, there are many believers who are, we regret to say, sadly misled. It must be remembered that it is not sufficient to see crystals under the microscope to be able to practically extract them, as there is a vast barrier to overcome before obtaining them for commercial purposes.

As regards the numerous patents that have had this object in view,—or, in other words, the facilitation of crystallization,—they have, in all cases, been worthless, and in a few years they have been a direct loss of $400,000. Not one of them has accomplished what was promised. These were not, as a general thing, original, but were simply a slight modification of supposed principles long since known. We may say, however, in defense perhaps of the well-meaning inventors, that they have confounded, in many cases, granulation with crystallization. The latter is essential for cane sugar. The crystallizable sugar contained in the sorghum plant diminishes as it matures, which is a great misfortune. If we admit that the proper time is seized for the manufacture of sugar, it must not be forgotten that whatever the amount is, as indicated by the polariscope, it does by no means follow that the same is expected to exist in the syrup. Consequently, in this transformation we have a loss of crystallizable sugar, and another loss when the attempt is made at granulation. It seems strange that investigators and writers upon sorghum and its utilization have invariably added the two sugars,—cane sugar (sucrose) and grape sugar (glucose). (If we refer to the Agricultural Reports for 1862, page 223, fifteen analyses of sorghum are given, and examples of this adding may be found.) Why the addition of two elements—the one desirable, and the other not? We

fail to see. If we subtract these (after having added the impurities to the glucose), as should have been done in all cases, we will have the maximum possible sugar. In nearly every case it will be found that the percentage of sugar is so small that its extraction will be practically impossible. Our Government published in 1878 a special report upon sorghum sugar, and we had the pleasure of examining the same with every possible care, and find the appliances for sorghum-sugar manufacture and its crystallization are completely forgotten. It is true that several machines are given which enable the reader to form a clear idea of the methods adopted by the Hindoos. But machines of practical value of modern origin for the crystallization have been overlooked. (Any ordinary vacuum pan does not answer the purpose.)

We give herewith a series of interesting figures based upon experiments made in Washington. As may be noticed, the last column represents the maximum (sucrose) sugar that may be practically extracted. This is obtained by the simple* method before mentioned,—subtraction of the sucrose from the total impurities. This should have been done in the Government publication just mentioned.

* In reference to the above, we would say, that in many cases the solids, not sugar, are omitted, we know not why. This would make the results still more unfavorable.

MISCELLANEOUS SORGHUMS.

Date.	*Variety.*	*Solids not sugar, average.*	*Percentage of glucose, average.*	*Percentage of sucrose, average.*	*Total impurities in juice.*	*Maximum practical sugar.*
Sept. 17	Egyptian corn	.84	4.1	4.5	4.94 3.07	0
" 11	Egyptian corn	.37	2.7	7.7	0.00	4.63
" 17	Fodder	2.05	3.1	1.4	5.15	0
" 11	Brown doura	12.51	.8	3.7	13.31	0
Oct. 1	Brown doura	4.88	2.7	3.7	7.58	0
Sept. 11	White doura	7.00	1.9	8.7	8.9	0
Oct. 1	White doura					
Aug. 23	Corn		4.8	5.6		
" 23	Corn		3.4	6.7		

LIBERIAN.

Date.	*Development.*	*Solids not sugar, average.*	*Average per cent. glucose in juice.*	*Average per cent. sucrose in juice.*	*Total impurities.*	*Total practical sugar.*
July 18	Flower-stalk just out and compact	.46	4.1	5.7	4.56	1.14
" 26	Flower-stalk spreading; seed milky	1.30	3.5	4.7	4.80	0.00
Aug. 7	Flower-stalk more spreading; seed milky		3.2	11.0	3.20	7.80
" 11	Seed browning; harder	2.14	2.4	12.9	4.54	8.36
" 13	Seed harder	1.77	2.0	13.8	3.77	10.03
" 16	Juice brown in color	3.27	1.3	14.3	4.57	9.73
" 20	Seed as before	2.31	1.5	14.4	3.81	10.59
" 22	Seed almost dry		1.4	14.7	1.40	13.30
" 26	Seed almost dry	1.21	1.4	13.7	2.81	10.09
" 30	Butt turned red at centre		1.0	12 2	1.00	11.20
Sept. 8	Ripe; seed dry	9.48	.75	8.35	10.23	0.00
" 13	Ripe; seed carried off by birds		.55		.55	0.00
" 15	Ripe and dry	5.42	.65	12.6	6.07	6.53
" 20	Ripe and dry	1.49	.8	14 25	2.29	11.96
" 27	Ripe and dry; largely suckered	1.53	.95	15.2	2.48	12.72
Oct. 3	Ripe and dry; largely suckered	2 74	1.1	14.15	3.84	11.31
" 13	Ripe and dry; juices bright red	3.35	.95	14.05	4.30	9.75
" 21	Juices bright red	3.49	1.1	11.8	4.59	7.21
" 29	Leaves killed by frost	3 48	2.1	13.9	5.58	8.32
Nov. 8	Quite dead	2.65	4.0	10.6	6.65	3.95
	FOREIGN.					
Sept. 17	Seed just brown; not in milk	.74	6 05	6.2	6.79	0.00
Oct. 1	Browning, but not much milk		8.55	8.50	8.55	0 00
" 8	Brown and in milk		6.65		6.65	0.00
" 24	Brown and hard		3.1	17.00	3.10	13.90

MISCELLANEOUS SORGHUMS.

Date.	Variety.	Solids not sugar, average.	Percentage of glucose, average.	Percentage of sucrose, average.	Total impurities in juice.	Maximum practical sugar.
Sept. 9	Gunnison	4.95	0.6	9.6	5.55	4.15
" 9	Gunnison		0.9	12.4		
" 16	Gunnison	4.62	0.6	13.2	5.22	7.98
" 20	Gunnison	2.50	0.7	15.3	3.21	2.09
" 27	Gunnison	2.21	0.6	15.5	2.81	12.79
Oct. 10	Mastodon	0.86	3.5	11.7	4.36	7.34
" 10	Imphee	.28	9.1	6.9	9.38	0
" 10	Black top	1.74	4.5	13.6	6.24	7.36
" 10	Oomseeana	1.70	2.3	14.4	4.00	10.4

EARLY AMBER.

Date.	Development.	Average solids, not sugar.	Average percentage of glucose.	Average percentage of sucrose.	Total impurities.	Maximum practical sugar.
July 18	Flower-stalks just out; compact	2.35	3.77	4.43	6.12	0.00
" 26	Flower-stalks begun to spread	2.53	3.14	7.85	5.67	2.18
Aug. 7	Flower-stalks spreading; seed milky	1.56	2.97	11.15	4.53	6.62
" 11	Seed browning; harder	1.43	2.36	13.78	3 79	9.99
" 13	Seed harder; stalk puckering	1.12	1.74	14.25	2.86	11.39
" 16	Seed harder; stalk puckering	1.00	1.54	14.67	2.54	12.13
" 20	Seed nearly dry, but crushable	3.25	1.60	14.13	4.85	9.28
" 22	Seed hard, but splitable		1.48	14.78	1.48	13.30
" 26	Seed hard, but splitable		1.31	14.45	1.31	13.14
" 30	Core of cane turning red	2.47	1.33	14.72	3.80	10.92
Sept. 8	Ripe; seed dry and mostly gone	9.77	.7	8.45	10.47	0.00
" 12	Ripe; seed carried away entirely	2.28	.6	14.75	2.88	11.87
" 12	Ripe and dry; carried away by birds	3.53	.7	14.4	4.23	10.17
" 16	Ripe and dry	2.16	.65	15.95	2.81	13.14
" 22	Ripe and dry	2.27	.7	14.8	2.97	11.83
Oct. 3	Ripe and dry	2.45	1.1	14.4	3.55	10.85
" 13	Ripe and dry		.7	15.8	.7	15.10
" 20	Ripe and dry	4 12	.95	15.75	5.07	10 68
" 29	Leaves killed by frost	3.08	1.1	17.0	4.18	12.82
Nov. 8	Quite dead	3.47	4.3	10.9	7.77	2.78
	FOREIGN.					
Sept. 11	Brown husks full of milk (D. Smith)	4.06	3.2	12.1	7 26	4.84
" 13	Just browning (Hutchinson)	1.70	3.5	3.5	5.20	0.00
" 17	Between hull and dough (D. Smith)	2.32	3.35	12.25	5.67	6.58
" 13	In dough (Hutchinson)	4.66	2.85	10.55	7.51	3.04

PEARL MILLET.

Date.	Development.	Per cent. of solids, not sugar, in juice.	Per cent. of glucose in juice.	Per cent. of sucrose in juice.	Total impurities.	Maximum practical sugar.
Sept. 10	Stamens still on	.....	1.6	3.7	1.60	2.10
" 10	Stamens fallen	.....	1.6	1.9	1.60	0.30
" 16	No change in appearance	3.07	.8	7.3	3.87	3.57
" 19	No change in appearance	3.03	1.5	7.0	4.53	2.47
" 25	Dry tops; suckering	1.29	1.1	8.7	2.39	6.31
" 29	Dry tops; suckering	.41	1.2	9 6	1.61	7.99
Oct. 4	Dry tops; suckers well developed	2.70	1.3	10.1	4.00	6.10
" 14	Leaves dead and yellow	2.00	2.0	11.03	4.00	7.30
" 20	Frost-withered	3.45	3.0	6.7	6.45	0.25
" 29	Quite dead	3.38	5.4	7.4	8.78	0.00
	FOREIGN.					
Oct. 24	Withered	5.94	.5	11.7	6.44	5.26

HONDURAS.

Date.	Development.	Average per cent. solids, not sugar, in juice.	Per cent. glucose in juice of butts.	Per cent. sucrose in juice of tops.	Total impurities.	Maximum practical sugar.
Aug. 12	No sign of flower-stalk; cane 7 ft. high	.....	6.2	1.7	6.2	0.00
" 19	Flower-stalk just out	.....	5.0	2.2	5.0	0.00
" 29	Flower-stalk spreading	.....	5.1	4.0	5.1	0.00
Sept. 10	Stamens just fallen; no milk	.....	4.0	6.2	4.0	2.20
" 10	Beginning to brown	.....	4.1	7.9	4.1	3.80
" 15	In first milk; browning	.81	4.0	8.9	4.81	4.19
" 19	In milk; brown	2.66	3.1	8.5	5.76	2.74
" 25	Full milk	1.12	3.8	9.4	4.92	4.48
" 29	Full milk	.71	3.3	10.6	4.01	6.59
Oct. 4	Dough	1.70	3.5	13.0	5.20	7.80
" 14	Dough	1.55	1.8	14.6	3.35	11.25
" 20	Harder	5.10	1.4	14.9	6.50	8.40
" 29	Harder; leaves dead	2.02	1.9	15.0	3.92	11.08
Nov. 8	Quite dead	1.89	3.1	13.4	4.99	8.41
	FOREIGN.—D. SMITH.					
Sept. 17	Not brown nor milky; heads well out	1.35	5.7	3.6	7.05	0.00
Oct. 1	Young; flower-tops spreading	.....	11.4	3.4	11.40	0.00
" 8	Browning	.62	8.1	5.6	8.72	0.00
" 24	Tall stalk; seed first milk	.....	6.5	13.0	6.50	7.34
" 24	Shorter and more stalky and riper	1.74	6.4	7.1	8.14	3.00
	ARSENAL.					
Sept. 30	Seeks not filled out	.....	7.1	3.1	7.10	0.00
Oct. 15	Seeds greenish brown	.....	8.8	4.5	8.80	0.00

CHINESE.

Date.	Development.	Average per cent. solids, not sugar, in juice.	Average per cent. glucose.	Average per cent. sucrose.	Total impurities.	Total practical sugar.
Aug. 6	Flower-stalk just out; compact	------	5.55	1.85	5.55	0.00
" 6	Flower spreading a little	.13	6.1	3.5	6.23	0.00
" 12	Seeds beginning to brown	.89	4.6	6.3	5.49	0.80
" 19	Seeds browner	1.36	5.25	6.45	6.61	0.00
" 29	Seeds soft, but not milky	------	3.4	12.15	3.40	8.75
Sept. 3	Seeds still green in parts and milky	------	------	------	------	------
" 3	Seeds dropping and hard	4.92	1.45	13.9	6.37	7.53
" 9	Seeds nearly gone	------	2.0	13.75	2.00	11.75
" 27	Seeds nearly gone	.48	.95	14.50	1.43	13.07
Oct. 3	Dry and ripe	8.03	2.4	11.65	10.43	1.22
" 14	Dry and ripe	2.21	1.6	15.05	3.81	11.24
" 21	Dry and ripe; red juice	2.93	1.4	14.85	4.33	10.52
" 29	Dry, and leaves killed by frost	2.83	1.85	13.15	4.58	8.47
Nov. 8	Quite dead	2.40	3.8	13.3	6.20	7.10
	FOREIGN.					
Sept. 11	Seed just forming (D. Smith)	2.08	6.3	6.9	8.38	0.00
" 17	Seed just browning (D. Smith)	.98	7.3	6.7	8.18	0.00
" 30	Seed in the milk	------	12.1	7.0	12.10	0.00
Oct. 8	Seed in dough	------	8.5	8.8	8.50	0.30

With *miscellaneous sorghums* five out of six would, if manufactured, yield no practical sugar, the remaining one 4.63 per cent., which is extremely small. The *Liberian* tests were twenty-four in all; six of these would give zero sugar, etc. The other series of *miscellaneous sorghums* were better as to results than the first, but the difference is not sufficient to justify any encouragement. The *early amber*, on the other hand, three out of twenty-four would give zero; with the *pearl millet*, three out of eleven. The *Honduras* was exceptionally worthless; eight out of twenty-one would give, as a maximum, if worked, zero sugar.

The *Chinese sorghum*, eight out of seventeen, would give zero percentage of sugar. We append a table in which is given a synopsis of a hundred and eleven experiments above referred to, where is shown the possible maximum practical sugar to be expected from the said hundred and eleven experiments.

SYNOPSIS OF EXPERIMENTS AT WASHINGTON.

POSSIBLE MAXIMUM SUGAR.

	0 per cent.	1 per cent.	2 per cent.	3 per cent.	4 per cent.	5 per cent.	6 per cent.	7 per cent.	8 per cent.	9 per cent.	10 per cent.	11 per cent.	12 per cent.	13 per cent.	Total of Experiments.
Miscellan's sorghums	5	--	--	--	1	--	--	--	--	--	--	--	--	--	6
Liberian	6	1	--	1	--	--	1	2	2	2	3	3	1	2	24
Miscellaneous	1	--	1	--	1	--	--	3	--	--	1	--	1	--	8
Early amber	3	--	2	1	1	--	2	--	--	2	4	3	2	3	23 plus 1 (1 of 15 per cent. of sugar.)
Pearl millet	3	--	2	1	--	1	2	2	--	--	--	--	--	--	11
Honduras	9	--	2	1	2	--	1	2	2	--	--	2	--	--	21
Chinese	8	1	--	--	--	--	--	2	2	--	1	2	--	1	17
Total	35	2	7	4	5	1	6	11	6	4	9	10	4	6	111

One, two, three, or four per cent. of sugar would not possibly pay for working. Consequently, we would have fifty-three samples yielding no sugar, which represent more than half of all tested. If an average be taken of the one hundred and eleven experiments, it will be found to be 4.5 per cent. of practical sugar. This already proves the problem to be impossible.

As may be noticed, thirty-five of them would yield zero. If we take the average of the hundred and eleven experiments we find, as a yield 4.5 per cent., which result cannot possibly be practically accepted. In other words our Government experiments, notwithstanding the favorable conditions under which they were made, prove that the sorghum utilization is a fallacy in every sense of the word. If this question of glucose be considered in comparison with the beet, all arguments are in favor of the latter, for the reason that no evidence of glucose is apparent in analyzing beet juices. Such are truths perhaps not entirely agreeable to those interested in the sorghum cultivation, yet we consider it our duty to call attention to it; and we will, in all circumstances, lose no opportunity in bringing our views before farmers and capitalists in general. In conclusion we would say that it is advisable for farmers to realize the above, and not spend their money upon patents that are worthless. If sorghum is to be grown for its syrup, or as a fodder, it will evidently render excellent ser-

vice; and it is to be hoped that these trials will end there, and that further attempts will be abandoned.

The More Recent Sorghum Investigations of 1880.

It was presumable that the more recent investigations would bring to light new ideas and methods. In reference to these, we would say that the experiments made during the month of October were by no means successful, as declared by the practical sugar chemist. An explanation of this was, the hurried erection of the mill, breaking of the bagasse knife, and frost in the field rendering sorghum samples worthless. Open pans were tried and abandoned; evaporation in vacuum pans was the only remedy, and sugar in very small quantities was made. The remaining syrup was sent to the Wilmington Beet Sugar Factory, where several hundred additional pounds of sugar were extracted. This was worth about five cents per pound instead of eight cents, as obtained from the beet in Delaware; it had a greenish color and a disagreeable taste, judging from samples that we saw and tasted. On the other hand, white sugar may be made from the beet direct. In the same preliminary report, published in February, 1881, an account is given of one hundred experiments made in Alabama, Arkansas, California, Connecticut, Rhode Island, Dakotah Territory, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia, West Virginia, Wisconsin, and only in one case a pound of sugar was made, and this was in Missouri. We would say, however, that one thoughtful planter estimates the value per pound if the sugar had been made.

In this, like all other cases, the want of facilities was the main and principal excuse for not obtaining sugar.

In June of 1881, Mr. Le Duc's second sorghum pamphlet appeared. This gives 3,601 analyses made during 1880. The various stages of the growth of the sorghum are graphically represented. The hybrid grown in California was, however, omitted, for reasons not explained. We have, with considerable care, measured from the graphical plates, at intervals of ten days (during the entire investigation), the amount of practical sugar possible to obtain from these various varieties. This has been tabulated.

SYNOPSIS OF EXPERIMENTS AT WASHINGTON, in 1880.

Table No. 1.—*Early Amber, Virginia.*

Number of experiments, -	1	1	1	1	2	5	1	Total, 12.
Percentage of practical sugar,	**0**	5	6	7	8	9	10	**AVERAGE 6.**

Table No. 2.—*Early Amber, Missouri.*

Number of experiments, -	1	1	2	3	1	4	1	Total, 13.
Percentage of practical sugar,	**0**	4	5	6	7	8	10	**AVERAGE 6.**

Table No. 3.—*Early Golden, Minnesota.*

Number of experiments, - - -	2	1	1	5	1	1		Total, 11.
Percentage of practical sugar, - -	**0**	6	7	8	9	10		**AVERAGE 5.**

Table No. 4.—*Golden Syrup, Ohio.*

Number of experiments, - - -	2	1	1	5	1	1		Total, 11.
Percentage of practical sugar, - -	**0**	5	7	8	9	10		**AVERAGE 5.**

Table No. 5.—*White Liberian, Virginia.*

Number of experiments, - - - - -	2	1	5	1	1			Total, 10.
Percentage of practical sugar, - - -	**0**	4	9	10	11			**AVERAGE 7.**

Table No. 6.—*Early Amber, Kansas.*

Number of experiments, - - -	4	1	1	2	2	2	Total, 12.
Percentage of practical sugar, - -	0	7	8	9	10	11	AVERAGE 6.

Table No. 7.—*Black Top, South Carolina.*

Number of experiments, - - -	2	1	1	5	1	1	Total, 11.
Percentage of practical sugar, - -	0	5	8	9	10	11	AVERAGE 7.

Table No 8—*African, Kentucky.*

Number of experiments, - - -	3	1	2	1	3	1	Total, 11.
Percentage of practical sugar, - -	0	6	7	8	9	10	AVERAGE 5.

Table No. 9 – *White Mammoth, Missouri.*

Number of experiments, -	2	1	1	2	1	3	1	Total, 11.
Percentage of practical sugar,	0	4	5	7	10	11	12	AVERAGE 7.

Table No. 10.—*Oomseeana, Ohio.*

Number of experiments, - - - - -	3	1	1	6	1	Total, 12.
Percentage of practical sugar, - - -	0	2	5	8	9	AVERAGE 5.

Table No. 11.—*Regular Sorghum. Ohio.*

Number of experiments, - - - - -	2	1	3	1	4	Total, 11.
Percentage of practical sugar, - - -	0	4	7	8	9	AVERAGE 6.

Table No. 12.—*Hybrid, Tennessee.*

Number of experiments, - - -	2	1	1	2	1	4	Total, 11.
Percentage of practical sugar, - -	0	2	5	9	10	11	AVERAGE 6.

Table No. 13—*Sugar Cane, Iowa.*

Number of experiments, - - - - - - - -	4	1	3	2	Total, 10.
Percentage of practical sugar, - - - - -	0	8	10	11	AVERAGE 5.

Table No. 14.—*Ooomsceana, South Carolina.*

Number of experiments, - - -	3	1	1	1	3	1	Total, 10.
Percentage of practical sugar, -	0	5	7	9	10	12	AVERAGE 6.

Table No. 15.—*Neeasana, Ohio.*

Number of experiments, - - -	4	1	2	1	1	1	Total, 10.
Percentage of practical sugar, -	0	6	7	8	9	10	AVERAGE 4.

Table No. 16.—*Goose Neck, Missouri.*

Number of experiments, - - -	4	1	1	3	2	1	Total, 12.
Percentage of practical sugar, -	**0**	6	7	8	9	10	**AVERAGE 6.**

Table No. 17.—*Early Orange, Missouri.*

Number of experiments, - - -	4	2	1	1	2	2	Total, 12.
Percentage of practical sugar, -	**0**	7	8	9	10	11	**AVERAGE 6.**

Table No. 18.—*Neeasana, Ohio.*

Number of experiments, - - - - -	4	1	2	4	1		Total, 12.
Percentage of practical sugar, - - -	**0**	4	7	9	10		**AVERAGE 6.**

Table No. 19.—*New Variety, Tennessee.*

Number of experiments, - - -	2	1	2	2	2	1	Total, 10.
Percentage of practical sugar, -	**0**	3	8	9	10	11	**AVERAGE 6.**

Table No. 20.—*Chimera, Virginia.*

Number of experiments, - - -	2	1	2	1	1	3	Total, 10.
Percentage of practical sugar, -	**0**	1	5	7	8	9	**AVERAGE 5.**

Table No. 21.—*Wolf Tail, Tennessee.*

Number of experiments, - - -	2	1	1	1	1	3	Total, 9.
Percentage of practical sugar, -	**0**	5	6	7	9	10	**AVERAGE 6.**

Table No. 22.—*Gray Top, Tennessee.*

Number of experiments, - - -	2	3	1	1	2	2	Total, 11.
Percentage of practical sugar, -	**0**	4	7	8	9	10	**AVERAGE 5.**

Table No. 23.—*Liberian, Ohio.*

Number of experiments, - - -	2	1	1	2	3	2	Total, 11.
Percentage of practical sugar, -	**0**	3	4	8	9	11	**AVERAGE 6.**

Table No. 24.—*Liberian, Ohio.*

Number of experiments, -	2	1	1	1	1	3	2	Total, 11.
Percentage of practical sugar,	**0**	2	3	4	6	8	9	**AVERAGE 5.**

Table No. 25 —*Oomseeana, Tennessee.*

Number of experiments, -	2	1	1	1	1	1	3	Total, 10.
Percentage of practical sugar,	**0**	2	3	5	8	9	10	**AVERAGE 5.**

Table No. 26—*Sumac, Alabama.*

Number of experiments,	2	1	1	1	1	2	1	1	Total, 10.
Percent. of pract'l sugar,	**0**	3	4	5	7	8	9	10	**AVERAGE 5.**

Table No. 27.—*Mastadon, South Carolina.*

Number of experiments, -	3	1	1	2	1	1	1	Total, 10.
Percentage of practical sugar,	**0**	3	4	5	7	8	10	**AVERAGE 5.**

Table No. 28—*Imphee, South Carolina.*

Number of experiments,	2	1	1	1	2	1	1	2	Total, 11.
Percent. of pract'l sugar,	**0**	2	3	4	7	8	9	10	**AVERAGE 5.**

Table No. 29.—*New Variety. Missouri.*

Number of experiments,	3	1	1	1	1	1	2	1	Total, 11.
Percent. of pract'l sugar,	**0**	1	2	4	5	7	8	10	**AVERAGE 4.**

Table No. 30.—*Sumac, Alabama.*

Number of experiments, -	2	1	2	2	1	1	2	Total, 11.
Percentage of practical sugar,	**0**	3	4	5	6	8	10	**AVERAGE 5.**

Table No. 31.—*Honduras, District of Columbia.*

Number of experiments, - - - - - -	6	1	1	2	2	Total, 12.
Percentage of practical sugar, - - - -	**0**	1	3	4	5	**AVERAGE 1.**

Table No 32.—*Honey Cane, Louisiana.*

Number of experiments, - - -	4	1	2	1	2	2	Total, 12.
Percentage of practical sugar, -	**0**	2	3	6	5	7	**AVERAGE 3.**

Table No. 33.—*Sprangle Top, Alabama.*

Number of experiments, - - -	4	1	1	1	4	1	Total, 12.
Percentage of practical sugar, -	**0**	1	2	4	5	6	**AVERAGE 2.**

Table No. 34.—Honduras, Tennessee.

Number of experiments, - - -	4	1	1	1	1	2	Total, 10.
Percentage of practical sugar, -	**0**	1	2	3	5	6	**AVERAGE 2.**

Table No. 35.—Honey Top or Texas Cane, Missouri.

Number of experiments, - - - - - - - -	5	2	2	1	Total, 10.
Percentage of practical sugar, - - - - -	**0**	3	5	6	**AVERAGE 2.**

Table No 36.—Honduras, Texas.

Number of experiments, - - -	4	1	1	1	2	1	Total, 10.
Percentage of practical sugar, -	**0**	2	3	4	5	6	**AVERAGE 2.**

Table No. 37.—Sugar Cane, Illinois.

Number of experiments, - - - - -	3	1	3	2	4	Total, 13.
Percentage of practical sugar, - - -	**0**	1	2	3	4	**AVERAGE 2.**

*Table No. 38.—Hybrid, Colorado.**

Number of experiments, -	45	7	7	2	1	2	1	Total, 65.
Percentage of practical sugar,	**0**	1	2	3	4	5	6	**AVERAGE 0.**

By many it may be argued that the averages of all the stages is not just, as sugar is to be manufactured when the most desirable period arrives; but in answer to this we would say that that period is of very short duration; and as no allowance has been made for it, it is but just to permit the first periods of sugar formation to enter as a factor into our calculations. We have, in all cases, neglected the fractions, for the reason they would not materially change the results. As may be noticed, these varieties were principally grown at the South, which evidently had a tendency to lead to better results than if at the North.

The average of these thirty-eight varieties and four hundred and seventeen experiments is 4.8 per cent. this is considerably higher than it would have been if we

* We were unable to deduct the above from the graphical plates for the reason that it is not given, but we have taken the average of sixty-five experiments.

had taken the averages of all the four thousand experiments made upon sorghum by the Agricultural Department in 1880. These, as given by them, would represent an average of 3.3 per cent. (see Table A), which evidently condemns this as a sugar-yielding plant.

TABLE A.

General averages for stages, as determined from the results from the same stage for all varieties of sorghum.

Number of experiments, -	6	2	0	1	1	3	4	1	1	Total, 19.
Percentage of practical sugar,	0	1	2	3	4	5	6	7	8	AVERAGE 3.3

American Production of Supposed Sorghum Sugar.

If we were to listen to the sayings of thousands of believers in the sorghum fallacy, sorghum sugar has long since been manufactured in the United States in paying quantities. Some of the Eastern States manufacture thousands of pounds yearly; one factory is now working on a practical basis as to profit; all of which leaves the problem no longer a doubt in the minds of the masses of our population. This sugar is of an excellent quality, and sold at eight cents per pound; one million pounds are produced yearly, etc. In answer to this we would say, that no such evidence appears in the Agricultural Reports. The supposed production of sorghum sugar from 1861 to 1877 is given:

SUPPOSED YEARLY SORGHUM SUGAR MANUFACTURED IN THE UNITED STATES.*

1861	80,400 lbs.	1870	109,940 lbs.
1862	137,430 "	1871	117,525 "
1863	183,795 "	1872	172,995 "
1864	208,300 "	1873	184,230 "
1865	280,330 "	1874	182,050 "
1866	511,565 "	1875	108,840 "
1867	140,658 "	1876	97,420 "
1868	200,676 "	1877	80,760 "
1869	224,000 "		

as shown after twenty years' agitation, kept up by those directly interested in sorghum machinery. The total amount produced, if it be actual, was the same in 1877 as in 1861, or, in other words, 80,760 pounds. (This represents 40,000 pounds less than was obtained at the Delaware Beet Sugar Factory, which worked but thirty days, under very unfavorable circumstances.) These figures also show that there has been a continual decrease in the production during the last ten years of this supposed sorghum sugar for the entire United States. Of the important States producing sugar and syrup, we may mention Ohio and Iowa. The total area devoted to the said culture in Ohio was 30,872 acres in 1862, and 9,426 in 1872, proving a decline of two-thirds in ten years. The sugar supposed to have been obtained was, however, greater by 10,000 pounds, notwithstanding diminished area devoted to its cultivation, proving how little reliance is to be placed upon the figures above given. In 1862 and 1866 the area devoted to it in Iowa was 37,607 and 25,796, showing a decline in the interest in sorghum in those years, possibly owing to the war, etc. Even if the interest had increased during

* The above table is taken from the Government Agricultural Report. We had hoped completing it, but give the task up in despair, as we have written letter upon letter to the Agricultural Department, at Washington, which, instead of answering our question as to the *total* production of sorghum sugar in 1878, 1879, 1880, sends in reply the sorghum reports above referred to, in which the data was not given. This evidently proves that the term SUPPOSED (that we make use of) are not exaggerations.

the same time, it would not have proved that the problem has been solved, and that there was in the future any prospect of the sub-variety finding an industrial application as a home sugar plant. In the Agricultural Report of 1867, page 78, we read the following, which is true: "Sorghum has suffered a natural decline for several years, which has continued causing despondency to producers." Many gentlemen, however, of good faith in years gone by, thought they obtained sorghum sugar, which we have great reasons to believe was not the case. Mr. J. S. Lovering, in 1857, published some startling accounts as to results from sorghum, with a similar sub-variety of sugar cane grown in Pennsylvania. But if there had been no mistake as to results, why are these not put into practice to-day, now that the country is so much interested? and why should they have been confined to the early stages of sorghum introduction, when but little or nothing was known concerning it? We regret that our ex-Commissioner of Agriculture, Mr. Le Duc, who had this home sugar problem so much at heart, should have been infatuated with a sample of sorghum sugar exhibited at the Minnesota State Fair in 1877, and from that time have abandoned a practical idea for a theoretical one, which up to the present day has amounted to nothing. We read in his report for 1877, page 229: "We cannot reasonably hope to find in beet culture a sure compensation for diminished cane crop." We beg to know why. Is it because inexperienced hands have led to poor results? Is it because we have experimented, rather than adhered to conclusions long since determined in Europe? Would not the results obtained at the Delaware Beet Sugar Factory in 1880, if they had had a longer duration, given a practical hint as to possibility of finding in the beet a sure compensation for the diminished cane crop?

Have the sorghum sugar results ever led to any reasonable hopes of such accomplishment outside of the laboratory experiments, which prove absolutely nothing?

If we, on the other hand, admit that Mr. Lovering's statements are correct, and, also, that the most recent data upon sorghum has, at least, some truth, the problem is not even then practical, and cannot compete with the sugar beet. We will make a few calculations based upon Government sorghum figures, and compare these results with those beet-sugar results already obtained. We give herewith the number of gallons of sorghum syrup obtained from an acre in several States of the Union; and, as shown, the average yield is 128 gallons; the average value, fifty cents per gallon.

As to the cost of a cultivation of sorghum per acre, we quote from a recent book upon so-called Northern sugar cane as follows:

Preparation of the soil for planting,	$2 00
Planting seed,	1 00
Working through twice with one-horse plow,	2 00
Hoeing and thinning four times,	4 00
Stripping blades, one hand four days,	4 00
Topping cane one and a half days,	1 50
Cutting and hauling cane to mill, one hand and team three days,	6 00
Use of land,	5 00
Total,	$25 50

In this same essay it is estimated that the cost of working up syrup is twenty cents per gallon. For 128 gallons before mentioned, it would be $25.60. The total cost of preparing the resulting syrup from one acre alone for market would be as follows:

For cultivation,	$25 50
For manufacturing,	25 60
Total,	$51 10

Table showing the average number of gallons of syrup obtained per acre for the entire United States.

State.	*Average number gallons per acre.*	*Average value.*
Alabama	122	$0 50
Arkansas	117	48
Colorado	116	90
California	196	50
Delaware	25	.....
Dakota Territory	112	66
Florida	145	30
Georgia	104	48
Illinois	132	46
Indiana	127	40
Indian Territory	127	75
Iowa	130	52
Kansas	114	49
Kentucky	119	39
Maryland	111	60
Michigan	166	51
Minnesota	138	56
Mississippi	111	49
Missouri	135	40
Nebraska	124	55
New Jersey	147	.....
New York	175	75
North Carolina	163	57
Ohio	151	48
Pennsylvania	138	50
South Carolina	94	50
Tennessee	138	41
Texas	114	57
Utah Territory	117	62
Virginia	113	55
West Virginia	127	51
Wisconsin	149	54
Average of total	128	50

From the sale of 128 gallons at fifty cents we have $64.00; less $51.10, equal to $12.90. If we admit that the refuse may be fed to cattle, and worth $5.00, this would represent a total of about $17.90; whilst beet-sugar profits would be $46.00 for the same area, or a difference of $28.10 to the acre. If we should admit that the working of sorghum sugar is practical, and that five pounds of sugar to the gallon may be obtained (which result is simply ridiculous, but it has been supposed for argument's sake that it is based upon the maximum as claimed by the sorghum

enthusiasts), and that this be worth eight cents per pound, we would then have 640 pounds of sugar at eight cents, which would be equal to $51.20, leaving, we will say, 320 pounds of molasses, or forty gallons, which we will admit as worth twenty cents per gallon, giving a total for the receipts of about $60.00. As for the cost of obtaining the syrup by improved methods, we will admit that it is represented by thirty-five cents per gallon of syrup obtained, or, in other words, seven cents per pound; consequently the cost of manufacture on a large scale of 640 pounds of sugar is $640 \times 7 = \$44.80$. We will then have for the net profit $\$60.00 - \$44.80 = \$15.20$, or about the same as is realized in selling the syrup alone.

In conclusion we would say, that we agree with the writer upon sorghum who says, "That the great object should be, first, to obtain that variety of cane which has proved most successful in crystallization, reject the unripe or inferior canes, cut and use only about two-thirds of the stalks, cutting off at six or eight inches above the ground" (this has to be done, and is yet to be). If the worthless portions are to be taken off and thrown away, there remains but little of the original stalk, thus rendering the problem still more difficult from a financial point of view.

AMBER CANE SUGAR.

Sugar from the Early Amber Cane.

FROM the close of the war (at which period it was discovered in Minnesota) but little has been accomplished with the early amber cane from a sugar point of view. Experiments without number have been made, and hundreds of gallons of syrup manufactured, and it may be justly stated that it is not from the amber cane we may look for a plant qualified to produce our home Northern sugars.

Government experiments have proved little or nothing. Those of the Amherst Agricultural College demonstrated the impossibility of any practical results being realized. These were conducted by Professor Goesmann, whose reputation as a chemist is sufficient to warrant the accuracy of the results obtained. They were made in August and September, 1878, and by closely examining them we find a possible maximum sugar of five per cent. in one case only, one of four, and the other of three per cent. The conclusions arrived at are the same as those our correspondents have led us to believe. We quote in consequence the following, which speaks for itself: "A part of our cane, after being cut, was left upon the field for about ten days before being ground and pressed; the remainder was cut without delay and sent to the mill. Examinations of the juice obtained from both of these lots of cane were made, and they admit of no other explanation but that the best course to pursue consists in grinding the matured cane as

soon as it is cut." We may consequently conclude from the above that the working cannot be carried on in the winter (the time most favorable, and, in our mind, the only practicable period in the Northern States).

If we should admit that the cane sugar exists in sufficient quantities immediately after cutting, storage is impossible, and this should be sufficient to condemn it, as we have already stated. But this is not the only difficulty; for, even if the entire freshly cut amber cane should be sent to the mill in one day, the juice, in the process of manufacture, undergoes changes,—for example: "The juice of a healthy, fresh-cut cane was tested before it passed into the defecator, and also subsequently; the juice, before being worked, contained 3.61 per cent. of grape sugar, and 8.16 per cent. of cane sugar. The resulting syrup was again analyzed: it contained grape sugar, 37.87 per cent.; cane sugar, 37.48 per cent." The conclusions to be drawn from these experiments are exactly the same as our own, and we quote, "It will be generally conceded that the sugar production from syrup like the above must remain a mere incidental feature in the amber cane industry in our section of the country [Mass.]."

What is here stated applies, we consider, to all the Northern States. In conclusion, we would say that we are convinced excellent results may be obtained in the South from the early amber, as shown by the Government analysis. The results are more satisfactory than with sorghum; but to extract the sugar from it is extremely difficult; and the percentage obtained decreases upon Northern cultivation.

CORNSTALK SUGAR.

Sugar from Cornstalk and Maize.

IN Prescott's "Conquest of Mexico," mention is made of sugar being manufactured from cornstalks. Dr. Ackerly wrote, some forty years ago, to one of the agricultural papers as follows: "If a semi-civilized nation on the continent of America make sugar from the stalks of Indian corn, why may not a more civilized nation of the present day, with the aid of art and science, do the same?" The above items are sufficient to show that even in this country the problem of cornstalk sugar was one of the first ideas of the early settlers, with the view of supplying their domestic requirements with sugar. We may ask, Could the product thus obtained be sold on our market to-day? We can positively say that it could not; for, as then, the sugar was not practically fit to eat, from our civilized point of view. (If, on the other hand, we consult the earliest documents, going back thousands of years, this sort of sugar was suggested; experiments, so called, were made, but syrup was the only reward.) The greatest excitement over the subject prevailed in 1840 to 1845 in the United States, from which day until within recent years nothing of moment has been said or done; consequently, if now desiring its introduction, knowing the experience of older nations, and after attempting its manufacture for a period of five years, we would, in 1881, be recommencing on a project upon which thousands of dollars have been thrown away. Prospects of any practical results being

obtained are by no means encouraging, notwithstanding overwhelming promises; and these will be all that the interested capitalists will receive for their money. We beg to recall a few past sayings:* "Complete success has attended the experiments on this subject in Delaware, and leaves no room to doubt the fact that if the stalk is permitted to mature, and without suffering the ear to form, the saccharine matter is three times as great as in the beet, and equal to the cane; and it will amply repay the manufacture into sugar."

We have not seen any analysis of cornstalks then grown, but, when compared with those of to-day, we fail to realize that therein three times the sugar is to be found that exists in an ordinary beet. But we would say, whatever it be in the latter case, it may be extracted; the same cannot be said of the former, judging from present existing results and methods. In 1843 Mr. Webb, of Wilmington, speaking of his experiments, stated: "We had ten gallons of syrup evaporated in a broad, shallow vessel; this crystallized readily and made good sugar." The amount of the latter is, however, not stated, hence we can draw no conclusions; for there can be no doubt that sugar does exist, but in what quantities? We know not. These efforts continued, and one year later (see Patent Office Report, 1843, page 58) the opinion was expressed that the results from Indian corn were most encouraging. The manufacture of sugar compared with that from the beet offers many advantages. It is more simple and less liable to fail; the machinery is less expensive, and the amount of fuel required is less by one half. The amount of sugar produced upon one acre of ground is greater, beside being of a better quality; we fail to appreciate what are the

*See Patent Office Report, 1842, page 5.

advantages in corn sugar; there is one, however, which is, that its manufacture exists in theory but not in practice. The machinery for corn sugar is at a minimum, for it does not practically exist. We also read that "the proportion of crystallizable sugar appears to be larger than is obtained from the cane in Louisiana." If such an assertion was true in 1844, why should it not be in 1881? Of all the attempts made in this cornstalk utilization, those in the Southern States were by far the most successful. Those in the North amounted to but little, and even in the latter case the syrup is said to have crystallized only after two months. Why this happened no explanation is given; six hundred and eighty-eight pounds, however, are said to have been obtained per acre. If we admit that this is the average, even with the above attempt of crystallization, the yield would be one-half that obtained from sugar beets in the Northern States; and the attempt to extract as much sugar from cornstalks as from beets would be absurd. What we have already said should be sufficient to condemn this plant as a source of sugar, even in the Southern States.

After many years of experiments it was concluded that the corn sugar would not easily crystallize, and until 1875 little or no mention is made of it in the Agricultural Reports. Some years ago, as we have already stated, when it was suggested and asserted that sugar could be made from cornstalks, hopes were again entertained as to the results that might be expected. Attention was called to the fact that if one acre out of fifty grown in the United States, or one-eleventh of the yearly acreage cultivated in Illinois, was utilized for sugar manufacture, it would supply the home demand.

A well-known author estimated that 21,700 pounds Kansas corn may be grown to the acre, from the stalks

of which could easily be extracted 1,800 pounds of excellent sugar. We find in the Agricultual Report of 1877 that Mr. Stewart argued that the limit of sugar to be obtained from an acre of land was 3,000 pounds. This would represent over double the amount realized on an average Southern sugar cane plantation. The farmers were to utilize the stalks, and each man was to be independent of his neighboring grocery. Was this ever realized? Not to our knowledge. If we should even admit that the factory said to have been established in Iowa is now working on a paying basis, it must not be forgotten that the cornstalks must be utilized immediately after cutting; and the manufacture of sugar (as in the sorghum utilization), when it exists, be carried on within restricted limits. Do not all the arguments we have expounded relating to sorghum also hold good in regard to cornstalk utilization?

If we should admit that the cornstalk be successfully and profitably utilized, it would have for effect the ruin of the soil, as comparatively nothing would be returned to the ground; while in the sugar beet cultivation the leaves and neck are left, and these contain a large amount of what has been extracted by the plant in growing.

CANE SUGAR.

Sugar from Sugar Cane.

FROM this source wonders have been expected in the United States since 1751, when it was first introduced into Louisiana. The yearly results, as to sugar yield, however, have been steadily on the decline, and many of the sugar lands were, in 1874, turned into rice fields. What was in years gone by obtained in Louisiana is not again to be hoped for many years to come. Such being the case, other Southern States have been suggested and tried; they give, in many respects, fair results, but whatever these have thus far been, they are so insignificant when compared with our total consumption of sugar that they can hardly be considered. But many argue that the time will come when Texas alone will grow sufficient cane to supply the entire North with sugar. Is this period near at hand? We think not, and trust that our people will realize the same. We doubt if the lands, for example of Louisiana, will be in a proper state for cane cultivation for hundreds of years to come. They, unfortunately, nearly all are subjected to a continual overflow; these were partly protected before the war by jetties, but the latter have since been destroyed, and to restore them to the proper state would necessitate a Government expense of millions of dollars; and local State taxation would be of little help, as the amount required is beyond the purse of the few. If the question simply depended upon the rebuilding of the jetties, we might

see our way more clearly; but the yearly repairs would amount to sums that would, in many respects, be greater than the value of the sugar cane grown and thus protected. We can only cite a letter from Mr. Norbert Lange, St. Charles Parish, in speaking of the ruin of these lands: "On my place, before the crevasse of Bonnet Carré, my crop ordinarily was from 200,000 to 300,000 pounds. The crops of seven of my neighbors were in the aggregate 2,600,000 pounds. All these lands, as also those of thousands of others adapted to the culture of the sugar cane, remain unaltered, for the reason that every year they are inundated by the waters of the river." We can only say, in addition to Mr. Lange's remarks, that if these sugar lands had any actual value they could not possibly be purchased for $15 to $20 per acre. Those interested assert that 2,000 and even 5,000 pounds of sugar may be obtained from cane grown upon them. These figures simply mislead the novice, as the average yearly production per acre was only 1,200 pounds; whilst in the West Indies it frequently runs up to 7,000 pounds per acre. On the island of Mauritius the latter yield is of very common occurrence. In the countries just mentioned, the production of sugar rose in ten years from 750,000 tons to 1,050,000 tons. During the same period the increase of beet-sugar production in Europe was two hundred per cent. The increase in the East Indies during the same time was forty-four per cent. Why are such results obtained in the above-mentioned climes and not here? Is the destruction of the jetties above referred to the sole cause of the trouble in Louisiana? or is it that the handling of the bagasse is not as scientific as elsewhere? or, again, has the successive planting of the same seed resulted in a deterioration of the stock? To actually bring about a reform, the entire system of cultivating the cane

should be changed; for example, deep plowing should be resorted to, and a scientific utilization of fertilizers; with this a complete and proper drainage of the swamps and lowlands would be needed, with plenty of labor, black and white, which is now so scarce (as the slave population is migrating north). The cane seed should be imported from other latitudes, and would thereby probably improve, etc. Can this be accomplished in a few years? We doubt it. Then, again, the question in our minds is (one that we have not seen discussed) whether the temperature of the Southern States is sufficiently high or constant for the proper maturity of the sugar cane. Possibly this may be one of the sources of trouble. By referring to the physical conditions of the climate of Mauritius, we find that ninety degrees represents the almost constant temperature for the year. If this is not as important as we consider it, it is, without a doubt, one source of difficulty which may partially explain why it is there are sugar lands which do not yield the proper amount.

Comparative Cost and Return from the Cane and the Sugar Beet.

Sugar Cane Costs and Profits.—In all cases here following we will take the average of the results obtained upon large areas,—for example, those in growing the sugar cane in Louisiana: Upon one hundred acres* under cultivation, 135,000 pounds of sugar were extracted; these were sold at eight cents per pound, and the total value of the cane was $10,800. Besides this there were 90,000 pounds of

* See Agricultural Report, 1872.

molasses which sold at four cents per pound; we have, consequently, as returns:

From sugar at eight cents per pound,	$10,800
From sale of molasses, -	3,600
	$14,400

The cost of cultivating one hundred acres was $5,000, or $50 to the acre. The expense of manufacture, including the overseer, etc., was $7,400.

For cultivating one hundred acres at $50 per acre, - -	$5,000
Expense of manufacture, - -	7,400
	$12,400

Consequently we have for profits:

Receipts, - - -	$14,400
Expenses, - - -	12,400
Net profit, - -	$2,000

or $20 per acre of land under cultivation.

SUGAR BEET COST AND PROFITS.—Our experience in raising beets has convinced us that fifteen tons to the acre is a just average for the entire Northern States; beets may be grown at about $45 per acre, but as we are in this argument to consider averages, we will take those of nearly two thousand farmers of Delaware, Maine, and Massachusetts. The average results obtained by them were ten tons to the acre. The average cost of raising beets was $50 per acre. As these were grown under contract, they were sold, we will suppose, at cost price; or, for argument's sake, we may admit that they were grown by the manufacturer, and $50* consequently represents the actual cost of cultivation, including seed and the various

* In the growing of over three hundred acres, by the Delaware Beet Sugar Company, this year, it is estimated that the above is a maximum figure.

operations, rent of land, interest of money invested in the agricultural implements, etc.

As for the amount of sugar that may be extracted, we will take the results obtained at Portland * in 1880, under unfavorable circumstances: from 70,000 tons of roots 420 tons of sugar were obtained, corresponding to a yield of at least six per cent. During the same campaign in Delaware, with fewer beets, this average was nearly maintained. We are also informed that at the Alvarado Factory these results were practically the same; consequently, with ten tons or 22,000 pounds, at six per cent., we would have 1,320 pounds of sugar, which were and may be sold at eight cents per pound, or $105.60; with this we would have, say, fifty per cent. of molasses, or 660 pounds, which were and may be sold at two and a half cents per pound (in Delaware and Maine the molasses was sold at twenty cents per gallon).

RETURNS.

From sugar at eight cents per pound,	$105.60
From molasses at two and a half cents per pound,	16.50
From pulp, forty per cent, or four tons at $1 per ton,	4.00
Total receipts,	$126.10

It has been generally admitted that the cost of working one ton of beets, including wear and tear of machines, interest on money, labor, etc., is $3 a ton. This is an average; consequently for profits we would have:

For cultivation of one acre of ten tons,	$50.00
Expenses of manufacture,	30.00
	$80.00

* See *The Sugar Beet* for description of Portland factory.

PROFITS.

Returns,	$126.10
Expenses,	80.00
Net profit,	$46.10

from one acre of land under cultivation.

These figures are as accurate as we can make them, and have been based on actual data obtained in the North with the beet, upon ordinary land and in the South with the sugar cane upon a Southern plantation. The difference, $46.00 less $20.00 or $26.10, favor of the Sugar Beet, we trust will be sufficient to convince our readers of the impossibility of the cane, under the best of circumstances in the South, competing with the sugar beet in the North, even by present methods. The transportation of the sugar north must be done in the one case; whilst in the other it need not be, for the reason that it is produced in the centre of demand. In the one case the article must be refined, and in the other that process is not requisite (by recent improvements refined sugar may be made directly from the beet).

Nothing is in the way for the complete success of the beet-sugar industry in our country but the confidence of our people (as they imagine that the problem is a difficult one), and the strict adherence to foreign methods.

Condition of American Sugar Industry.

Too much confidence is placed in the future possible Southern cane sugar supply; and the complete ignorance of the masses of the difficulties to be overcome may partially explain why more has not been done, and why the industry has not been

ere this established in America. Sugar cane has never been able to supply our home demand with sugar, whilst the beet has, in Europe, permitted for years an immense export of sugar. We fear that but few of our readers realize the exact condition of the home sugar production from various sources, consumption and importation. With the view of rendering it comprehensible, we give a table based on official data, for example:

In every State, with two exceptions, *i. e.*, Tennessee and South Carolina, there has been a falling off in ten years. In Mississippi, for example, this has been 1000 per cent. The table shows that, while the total home production has not regularly diminished, it has practically, for the reason that nearly 30,000,000 pounds less are made to-day than twenty years ago.

The production in Louisiana was in 1860 one-third of the total (as before stated), but to-day it is so small as to be doubtful of ever again attaining this same proportional growth. One curious fact relating to our home sugar production is, that whilst it has practically yearly decreased the population augmented, and the production remaining the same, the total exportation of sugar has increased; it was 4,466,031 pounds in 1860, whilst it was 54,073,814 in 1877.

Whilst our total imports were in 1860 but 694,879,795 pounds, in 1877, for example, they had increased over one hundred per cent., and were 1,623,973,537 pounds. In 1863, on account of the war, there was a slight falling off; but from 1868 to the present day the increase has been very steady, with little or no fluctuation.

During these same years the exportation of foreign sugars has fallen in 1863 from 34,016,070 pounds, to 3,122,956 pounds in 1877, from which period it has somewhat increased.

TABLE SHOWING THE GENERAL MOVEMENT OF SUGARS IN THE UNITED STATES.

Years.	Domestic.		Consumption.				Average consumption per capita.
	Produce.	Exports.	Foreign.	Domestic.	Total.	Population.	
Eighth Decennium.	POUNDS.	POUNDS.	POUNDS.	POUNDS.	POUNDS.	NUMBER.	POUNDS.
1860	302,209,105	4,466,031	660,777,673	297,743,074	958,520,447	31,443,321	
1861	312,294,955	6,511,134	729,404,775	305,783,821	1,035,188,596	32,238,403	
1862	595,980,722	2,755,252	533,591,039	593,225,470	1,126,816,509	32,987,985	
1863	281,923,795	3,595,009	502,448,466	278,328,786	780,777,252	33,211,430	
1864	128,568,644	2,328,483	605,949,979	126,240,161	732,190,140	33,345,224	
1865	51,903,854	2,132,147	614,067,543	49,771,707	663,839,250	33,394,882	28.16
1866	58,715,645	4,460,138	991,496,617	54,255,507	1,045,752,124	34,324,665	
1867	82,698,658	8,197,550	939,806,458	74,501,108	1,014,307,566	35,342,849	
1868	76,689,844	2,282,655	1,000,886,403	74,407,189	1,075,293,593	36,361,669	
1869	129,142,286	3,187,993	1,018,807,068	125,954,293	1,144,761,361	37,400,130	
Ninth Decennium.							
1870	132,979,178	4,501,221	1,216,459,872	128,477,957	1,344,937,829	38,558,371	
1871	208,196,046	3,945,923	1,231,883,061	204,250,123	1,436,133,184	39,723,755	
1872	186,106,426	4,590,932	1,412,919,438	181,515,494	1,594,434,932	40,967,095	
1873	163,955,047	10,222,728	1,485,657,191	153,732,319	1,639,389,510	42,265,762	
1874	141,629,424	15,585,587	1,644,765,505	126,043,837	1,770,809,342	43,456,931	
1875	184,536,695	35,694,888	1,649,100,179	148,841,807	1,797,941,986	44,588,083	38.29
1876	214,974,473	52,024,916	1,658,719,324	162,949,557	1,821,668,881	45,687,668	
1877	241,286,958	54,073,314	1,505,086,114	187,213,644	1,692,299,758	46,761,551	
1878	196,132,588	----------	1,552,875,112	147,049,258	1,699,924,370	47,874,485	
1879	319,305,006	----------	1,598,461,986	239,434,798	1,837,896,784	49,500,000	
Tenth Decennium.							
1880	264,283,037	----------	1,601,200,417	198,945,420	1,800,145,837	50,152,866	

TABLE SHOWING THE GENERAL MOVEMENT OF SUGARS IN THE UNITED STATES.—*Continued.*

Years.	*Foreign.*			*Value of foreign sugar consumed.*		*Value of foreign sugar consumed.*
	Imports.	*Exports.*	*Difference.*	*Value.*	*Paid for Customs.*	*Total.*
Eighth Decennium.	POUNDS.	POUNDS.	POUNDS.	DOLLARS.	DOLLARS.	DOLLARS.
1860	694,879,795	34,016,070	660,777,373	29,291,087	7,029,861	36,320,948
1861	809,815,489	80,408,714	729,404,775	27,254,957	10,011,932	37,266,889
1862	557,143,184	23,552,145	533,591,039	19,049,781	10,724,725	29,774,506
1863	522,131,247	16,135,557	502,448,466	17,642,237	10,272,961	27,915,198
1864	632,248,612	27,271,713	605,949,979	27,069,139	12,317,647	39,386,786
1865	651,971,882	30,743,484	614,067,543	23,696,358	18,972,632	42,668,990
1866	1,000,076,709	8,580,092	991,496,617	40,182,049	30,633,113	70,820,142
1867	849,108,911	12,210,707	835,416,841	38,513,055	28,589,781	67,102,836
1868	1,121,221,670	16,112,818	1,105,108,852	43,434,090	30,455,442	73,889,532
1869	1,247,885,371	17,828,678	1,230,056,693	48,258,660	30,929,337	79,187,997
Ninth Decennium.						
1870	1,196,829,389	18,333,902	1,178,495,487	60,270,688	36,829,037	97,099,725
1871	1,277,525,009	10,364,161	1,267,160,848	60,849,370	30,758,657	91,608,027
1872	1,509,249,507	12,122,280	1,497,127,227	76,029,865	28,876,131	104,905,996
1873	1,568,393,877	23,930,453	1,544,463,424	79,513,278	29,842,942	109,356,220
1874	1,701,354,312	19,310,777	1,682,043,535	81,491,851	32,499,835	113,991,686
1875	1,797,586,806	11,200,857	1,786,385,949	71,800,598	34,662,057	106,462,655
1876	1,494,065,427	15,870 600	1,478,194,827	67,030,351	39,450,917	106,481,268
1877	1,623,973,537	3,122,956	1,620,850,581	73,780,829	35,274,468	109,055,297
1878	1,537,451,934	6,015,973	1,531,435,961	72,729,151	36,387,463	109,116,614
1879	1,834,365,836	10,388,600	1,823,977,236	71,651,997	37,294,197	108,946,194
Tenth Decennium.						
1880	1,829,302,684	10,498,202	1,818,804,482	79,642,317	39,107,256	118,749,573

As shown, this amounted to $118,749,573 in 1880, including customs, which should not be neglected, for when the foreign sugar question is discussed, and the benefit to be derived from the utilization of home capital and labor considered, the customs duty is a benefit to the Government, but it is of little help to the individual in the way of actual employment, when compared to what it would be if invested in the home sugar industry. It is an immense help towards making our people realize the importance of the question of home production, and is the only practical method to be adopted. Such being the case, it becomes evident that the importance of home sugar manufacture cannot be overestimated.

Whilst in this country the consumption is nothing like what it is in England (for example, there the average is nearly sixty-four pounds *per capita*), it is on the increase, and will, without doubt, attain that figure within the next ten years; for whilst in the eighth decade 28.10 pounds were consumed *per capita*, it was in the ninth 38.29 pounds; and in the tenth decade, if the same ratio of augmentation should exist, the above expectation will not be an exaggeration. The consumption of foreign sugars has more than doubled in twenty years. For 1860 it was 660,777,673 pounds; in 1880, 1,601,200,417 pounds; and the consumption of home sugar has decreased 100,000,000 pounds in the same time.

MAPLE SUGAR.

Sugar from the Maple Tree.

THE extraction of sugar from the maple tree is evidently one of the most simple methods of obtaining cane sugar. The coloring matter may be got rid of by a series of filtrations, but maple sugar is not a practical source for the sugar supply of the country. Many with whom we have corresponded assert, that it is simply a question of how many trees are utilized; that these exist at present in sufficient number to meet the home demand. It is also contended that little or no harm results from the tapping. But we can positively assert that there are to-day but few rock and black maple trees standing that were utilized for maple sugar manufacture some forty years since. Those which have never been thought of for maple sugar, are rapidly disappearing before the axe; groves of them are consequently swept away. The protection of the farm by these trees, and their view, so highly pleasing to the eye, is generally entirely neglected. The desire for a timber profit (which evidently in many cases represents cash) is so tempting to the owner of the land, that he overlooks the probable future these trees may have in store for him. This vast destruction of trees is too terrible to think of. In France, there exists a law, which prescribes that every tree hewed to the ground must be replaced by another. In this manner the country, its lands, its climate, etc., are protected; but unfortunately this law does not

exist in the United States. We are convinced that entire neighborhoods, in certain localities, have been changed by this system of tree-cutting. The time is not far distant if such a practice continue, when the beautiful green Vermont will be a story of the past. It is all very well to argue that no harm is done by the simple extraction of a certain number of gallons of sap each year; but it is, we consider, in no way rational to suppose that this continual bleeding is beneficial. The period for tapping is any time from the autumn to the spring of the year; better during the former than the latter season. It is also admitted that the continual tapping of the tree increases the quality of the sap; hence the natural tendency to finally kill the tree. It is also a well-established fact, that maple trees to give a satisfactory yield must not be too near together; hence the importance of thinning them out. Troughs and spouts, from which the sap flows from the tapped portion of the tree, are made of wood. The boiling or concentration of the sap is done on the spot; and to obtain one to two hundred pounds of sugar a cord of wood is used as fuel; hence for these reasons the necessity of wood in large amounts, which is supplied by the cutting down of more trees. We may conclude that the entire maple business, however profitable it may have been in years gone by, has no great future. Among the farmers this maple sugar manufacture is said to be a social enjoyment, and we trust that it will remain within these limits, and be carried on as it was during the earliest days of the settlement of New England, and not be considered as a grand State industry, as argued in Vermont some years past, during which period the amount of maple sugar manufactured in one year would have permitted the building of a wall around the entire State eight inches high and eight inches thick. The yield of the

trees during that period was extremely variable, but the following gives a fair average: From 1,150 trees at Canterbury, in Vermont, 618 barrels of sap, or 19,777 gallons, were obtained, from which was manufactured 4,000 pounds of sugar, or one pound of sugar per five gallons of sap. On the other hand, in Cambridge, Vermont, from 75,730 trees 221,350 pounds of sugar were made, or an average of about three pounds per tree. Upon this basis we beg to make a small calculation, showing the number of trees that must necessarily be planted to furnish all the sugar we consume in the United States. The consumption was, in 1877,* 1,692,299,758 pounds. The number of maple trees to furnish this would be 564,066,583. It is admitted that two men can, in the season, take care of three hundred trees, or one hundred and fifty trees per man, consequently for the tapping of the trees alone it would require $\frac{564,066,583}{150}$ = 3,760,443 men. If the boiling and the preparing of the sugar for market (in and out of the factory) should require, say, as many more hands, the total number would then be over 7,000,000 men, or nearly every available working man in the United States. This very idea prevents one from looking to the maple tree as a source for home sugar supply.

Home Production of Maple Sugar.

The following table gives the home production of maple sugar, which shows that in 1877, 1,000,000 pounds less were produced than in 1861. As may be noticed in table showing the production in various States in the Union, with the exception of Illinois with an increased average production in ten years

* The calculations were not based upon the consumption of 1880, for the reason that we received the data a few days only before going to press.

of 2,000 pounds, but a decrease of 100,000 pounds since 1850, Ohio with an increase of 24,000 pounds, and Tennessee of 19,000 pounds, there has been a rapid decrease in the production of each State from 1860 to 1870, and a still greater decrease since 1850. In New York, for example, there have fallen off, since 1850, 4,000,000 pounds; in Vermont, since 1860, 1,000,000 pounds.

TOTAL PRODUCTION OF MAPLE SUGAR IN THE UNITED STATES.*

1861	42,000,000 lbs.	1870	28,443,645 lbs.
1862	44,000,000 "	1871	30,756,000 "
1863	41,500,000 "	1872	31,682,000 "
1864	40,500,000 "	1873	32,157,000 "
1865	39,740,796 "	1874	33,044,200 "
1866	37,532,000 "	1875	43,197,930 "
1867	35,654,000 "	1876	43,288,080 "
1868	33,421,000 "	1877	41,000,000 "
1869	29,114,500 "		

MAPLE SUGAR MANUFACTURED IN THE UNITED STATES.

State.	*Sugar.*		
	1870	1860	1850
	POUNDS.	POUNDS.	POUNDS.
Illinois	136,873	134,195	248,904
Indiana	1,332,332	1,541,761	2,921,192
Iowa	146,490	315,436	78,407
Kentucky	269,416	380,941	437,405
Maine	160,805	306,742	93,542
Massachusetts	399,800	1,006,078	795,525
Michigan	1,781,855	4,051,822	2,439,794
Minnesota	210,467	370,669	2,950
Missouri	116,980	142,028	178,910
New Hampshire	1,800,704	2,255,012	1,298,863
New York	6,692,040	10,816,419	10,357,484
Ohio	3,469,128	3,345,508	4,588,209
Pennsylvania	1,545,917	2,767,335	2,326,525
Tennessee	134,968	115,620	158,557
Vermont	8,894,302	9,897,781	6,349,357
Virginia	245,693	938,103	1,227,665
West Virginia	490,606		
Wisconsin	507,192	1,584,451	610,976
United States	28,443,645	40,120,205	34,253,436

* We regret to have been unable to complete the above, but the reasons were before explained.

POTATO SUGAR.

Sugar from the Sweet Potato.

WE cannot admit the sweet potato as a source of Northern sugar supply, for the reason that it is essentially a Southern vegetable.

It is true the sandy soils of New Jersey have yielded satisfactory results as to the number of bushels grown to the acre, but we know nothing of their saccharine qualities. We are convinced, however, that this sugar percentage would be less than it would have been had these roots been grown at the South. For example: sweet potatoes raised in South Carolina contain more sugar than those of Virginia; and it is presumable that those raised in Vermont would be inferior to others of Louisiana.

The maximum sugar existing in the sweet potato, to our knowledge, in the Southern climes, is ten per cent. We have not been able to find any data as to the yield per acre to be expected North, but we are informed that the Southern yield is about three times that of corn, or, in other words, about 6,000 pounds, or less than three tons per acre. (This latter may be taken as a basis.) The maximum possible sugar to be extracted from this would be, say, six per cent., or, perhaps, 400 pounds. If this should be sold at eight cents per pound, it would represent $32.00. If we admit that the total residue molasses is 300 pounds, and if this be sold at two cents per pound, it would represent $6.00, or a total for the receipts of $38.00. As for the cost of raising the sweet potatoes, it would

be at least $40.00 per acre. If the cost of manufacture should be identical with that required by sugar beets, we would have for the three tons $9.00, or a total of $49.00 for the cost of cultivation and manufacture. The profits would consequently be negative, or, in other words, there would be a loss of $11.00. If we should admit that by careful selection of seed, and the most improved methods of cultivation upon suitable lands, the average yield to the acre would become equal to that of sugar beets, or ten tons, it would necessarily be a crop (as it always has been) upon which very little reliance could be placed, in consequence of the extreme tenderness of the plant. We are willing to throw aside these arguments, and admit that it is equal to the beet from every point of view, but there remains a factor which cannot possibly be overlooked, and that is a natural color peculiar to this sugar; and this cannot be eliminated by any known economical method. If we should admit that it could be done, the cost of the sugar must necessarily be greater than were there no necessity for the expensive removal. Sugar, to yield a high price, must be free from all foreign substances.

Sugar from the White Potato.

The idea of this source is foolish in the extreme. Many argue that sugar has been made from it. So it has, but not cane sugar. The starch sugar generally referred to is obtained by the simple addition of an acid, and the whole becomes changed into grape sugar or glucose. Many other substances may be used for the manufacture of this same sugar, such as paper, saw-dust, flax, cotton and linen rags, sea-weeds,

etc. All of these may be transformed into sugar by two chemical changes. Calculations are, we consider, in this case unnecessary, for this source will never supply the home demand with sugar, unless glucose be transformed by an unknown principle into cane sugar (sucrose).

WATERMELON SUGAR.

Sugar from Watermelons.

SOME few French and German writers many years ago expressed their opinion that the melon would be a capital plant for sugar manufacture. Factories are said to have existed in Hungary and Northern Italy, but we have not, during the last ten years, seen any accounts of results there obtained. With the view to home sugar manufacture, a factory was started, with a capital of $200,000, in California, having for object the utilization of watermelons. What success was there obtained we have never heard, as the results were not published in the Government Agricultural Reports. One of the arguments advanced in favor of the melon utilization is, that with a small capital the farmer, or a combination of a few farmers, may make excellent brown sugar for domestic usage, on a total capital of $1,000. If surplus sugar is produced, this could be sold to the refiner, who could manufacture from it an excellent white and refined sugar. These same theories have been advanced for every plant that has been proposed for Northern sugar for the past fifty years (and we have discussed them under the head of Sorghum, etc.). And it is also argued that working of melons into sugar may commence a month earlier than with beets. But how can this be, when the necessary temperature for their complete maturity has not existed? Whilst in New Jersey the melon may be grown and ripened, apparently,

upon a sandy soil, sufficiently so for eating (in consequence of the surplus radiated heat), it is not, on this account, suitable for the manufacture of sugar. The ripest, and, consequently, those containing the most sugar, are to be found in Southern Hungary, Egypt, Persia, Italy, India (grown on the river edge where the cane will not flourish); the temperature in those climes being sufficient for the complete maturity of the melon. It requires a subsoil slightly damp.

In growing this fruit it has frequently been suggested to plant a crop between the rows, to economize the land; but we have reasons to believe that the result as to the quality, etc., would be sadly impaired. It is contended that the cost of cultivation of melons is one-fourth that of beets; but we doubt it, as experience has, in every case, proved the contrary. The ploughing of the field for beet cultivation is an actual outlay at the commencement, but is in reality an economy for subsequent crops. If plowing several times should be resorted to, it would not leave the ground in a condition like it is after a crop of beets. Argument in favor of melon cultivation and utilization is, that a larger amount may be sold at retail, representing an immense revenue, which is admitted would be greater than could possibly be expected from beets. But we would say in answer, the experience in beet growing in America has been that the farmers estimate, in many cases, there is more profit derived from feeding them to cattle than selling to the factory at $5 a ton, in consequence of their immense feeding qualities. If only ten tons to the acre be obtained, this would represent a value for fodder of $50; we know of no other plant of which the same may be said.

It is true that melons yield seed every year, so does sorghum; and beets require two years for matu-

rity, occupying, it is true, the soil twice, whilst the other plants but once. But the advantage is greatly in favor of the beet, as it permits a principle of selection that could not otherwise possibly exist, the proof of which being that the beet of the past cannot be compared with the beet of to-day. Little, however, has been done to ameliorate the melon from a sugar point of view. The beet seed in beet-growing districts is sold by specialists who do nothing else, and they guarantee a given result as to yield and sugar percentage. As for the value of the melon seed for the manufacture of oil, this may, without doubt, be extremely profitable, as sixteen per cent. of the total weight of the melon are said to be extracted; but we doubt whether the profits from the same would, as many contend, represent one-half the cost of cultivation. It is true that beet seed cannot be used for this purpose; but the latter seed are grown only in amounts needed, and consequently from them a profitable selection may be made, and the remainder sold at a reasonable price. When comparing the cost of harvesting in the two cases, in one it is comparatively easy work, it being sufficient to take the melon from the vine and throw it into carts; whilst in the other, beets must be pulled or taken from the ground with a special harvesting appliance, the leaves being twisted off and left upon the soil, consequently the cost for this operation is greater for the beet than for the melon; but the tearing up of the soil for some depth in this work is most beneficial. From the time the roots arrive at the factory until they leave they are not subject to manual labor. Is this so with the melon? To our knowledge it is not. For no appliance could possibly be made that would empty the latter of its interior, and consequently it must be done by hand; which operation, to be effectual, must necessarily be extremely

expensive. Any fruit or root must permit of preservation during three or four months at least if to be used for sugar manufacture. The watermelon crop cannot be kept during that time. The work of a sugar factory during the summer months would not be as profitable as during the winter, in consequence of the fermentation to be contended with; whilst the beet may be preserved during four to five months of the winter in an excellent condition. Cantaloupes should be worked two days after harvesting (as admitted by advocates), otherwise they become too ripe, and the sugar disappears. This, even if the problem were practicable, would condemn their usage. The working (according to theory) of squashes, pumpkins, and cantaloupes, differs essentially from that of the melon-sugar manufacture,—the rind being utilized, as it contains a small percentage of sugar. As may be imagined, the impurities the juice contains under these circumstances would be considerable. The same may be said of pumpkin utilization, from which some argue that forty per cent. of sugar may be extracted; but we would like some practical figures demonstrating the truth of the assertion. It is true that in the process of making sugar from melons no water need be added; but, on the other hand, the melon juice is extremely diluted and does not ferment in a few hours, whilst beet juice does. If, however, the latter be mixed with water to the same degree as the melon juice, we are convinced there will be no difference in the fermenting qualities.

The portion of the beet which grows above ground is worthless for sugar manufacture, but the entire melon is equally so if the temperature is not sufficiently high. It is frequently asked why it is that red garden beets are not used for sugar manufacture, as they are far superior in taste to the well-known sugar

beet. The reason is that the coloring matter would be extremely difficult to extract. The same argument applies to many other plants, and we are convinced that the watermelon is one of them. The cost of the melon sugar is said to be less than from any other source; we are willing to believe this, but we have never seen any practical data as to the results obtained.* Factories may, as contended, exist in the countries already named, but the sugar and revenue from the same have not, to our knowledge, ever been published. It is true that the washing of the beets is an operation to which the melons need not be submitted, but it is continuous, and done at a comparatively small cost,—a single machine performing work for 200 tons or more a day, and using only the waste steam of the factory. The slicing and rasping is extremely rapid, and requires but little care. The pressing of the juice being done by hydraulic presses is evidently not continuous, but the diffusion, etc., is. The cost of a melon factory is sadly exaggerated by those interested, who contend that with $10,000 as a first investment we are to obtain six per cent. for our money, and a larger dividend. When it is admitted that a still smaller factory may be started on a capital of $1,000, it is simply acknowledging a complete ignorance of the subject under discussion.

* In the Agricultural Report of 1844, page 139, mention is made of an excellent syrup manufactured in South Carolina. But how about the sugar? We have no hopes of this source as a Northern home supply.

BEET SUGAR.

Sugar from the Sugar Beet.

WE think it hardly worth while to repeat what was said as to the advantages of the introduction of the sugar beet into the United States, but to simply assert that it is the only possible plant which can supply the North with sugar, when it be once taken hold of by our farmers, and tillers in general. The results at Portland and Wilmington were satisfactory, and proved beyond a doubt that if the supply of beets had been sufficient, the supposed failure of the beet sugar enterprise would no longer have been considered. On the other hand, excellent sugar was made, and sold on the market with the same ease as any of the imported. The factory at Alvarado not only has been a success, but the stockholders received last year a dividend, which was the first declared by any American beet sugar factory.

In Canada several new establishments have been organized, and are being built by experienced hands. These will be worked by competent men. The farmers are there interested in the subject, and success is assured; consequently the prospect of the final establishment of the sugar beet industry in America has never appeared more favorable. Would it not be well for all interested in the good of the country to exert themselves in aid of a plausible cause rather than in a scheme originally theoretical, and which has remained so? The sugar beet, and the manufacture of sugar therefrom, does not depend, in the Northern

States, upon the building of jetties, the employment of Chinese labor, or upon a temperature for the maturity that is never attained. Neither does it depend upon the refiner, after it has traveled hundreds of of miles (thus increasing its cost), or upon the drying-up of thousands of acres of swamps, etc. (where it should be grown but cannot be), or upon the utilization of unpopulated districts, where labor is scarce. The manufacture of beet sugar is not based upon a series of hypotheses absurdly false, such as comparing it with another plant of the same kind, but superior to it, whose juice contains but a small percentage of impurities, in which case the crystallization is comparatively easy. Sugar may be made from the beet during a period of a few hours' visit at the factory; whilst, on the other hand, if one should attempt to use the sorghum or the early amber, one month after harvesting, several weeks would be required for the processes. What is supposed to be true, relating to the sugar beet, is true; in other words, it is a Northern sugar-yielding plant, as it has proved for fifty or more years in Europe. The coloring substances nearly all other sources of sugar possess, and which cannot be eliminated, are in the beet-juice entirely extracted. No money need be spent on unnecessary experiments,—these have all been made in Europe. Is it not consequently important that our Hon. Commissioner of Agriculture, G. B. Loring, should ask for a Government appropriation, having these facts in view? As a hearty support of this kind would, without doubt, be advantageous, and possibly the only means of attaining that which could not otherwise be achieved, we have endeavored to call attention to the fact that sugar beets in the North, when grown under ordinary circumstances, may compete with the sugar cane on a well-organized Southern sugar plantation; and they will,

without a doubt, act as an agricultural reformer. This can never be accomplished with the sugar cane, or its sub-varieties, for the reason that the system of cultivation of sorghum, etc., is closely allied to that of the corn, from which the American farmer can learn but little; whilst, on the other hand, the beet teaches new principles and puts the land in excellent condition for subsequent crops. The importance of the rotation becomes evident, as already stated. Many argue against the sugar beet industry, that it requires a considerable capital for commencement, and the risks are such that but few are willing to invest their money therein. It is extremely rational that there should be a feeling of the sort, for the reason that other industries may be worked upon a small scale for a trial, but the beet-sugar manufacture cannot be; and any establishment started with less than one hundred tons a day capacity, and a capital of less than $200,000, must not expect to succeed. We have now in this country too many examples of failures resulting from these foolish attempts. The industry should not be managed by inexperienced hands; it does not pretend to be within the easy reach of every farmer and household, as the sorghum and maple are said to be. We beg to call attention to the fact that by a judicious management a beet-sugar factory may be started on a small capital, and will lead to sugar results no imaginary sorghum mill has ever attained, or perhaps ever will. An idea has long since been expounded, and in Europe has proved to be excellent; and it would be still better in America. It consists in a utilization of the beet which would enable experience to be acquired by our farmers as to the best methods of planting, and the most satisfactory fertilizer to be used upon a given soil, after having judiciously selected the locality. This proposition is simply distilling the beet juice with the

view to alcohol manufacture; not spirits of a secondary quality, but rectified alcohol fit for the use of laboratories and pharmacies, marking, say, 95° *B.* This evidently requires a special beet-distilling apparatus. It would lead to a positive failure if attempts were made to utilize a whiskey-still, or some other similar appliances. As for special work special appliances are required, so in beet-juice distillation volatile oils are to be contended with, which are unfamiliar to the grain distiller. The refuse pulp may be sold for manure, or, better still, used as a fodder. If the latter plan be adopted, it may be safely said that alcohol may be manufactured from the beet that could compete with corn or any other substance (having sugar in its composition), for the reason that the mash from a corn distillery is nothing like as valuable for a fodder as the beet refuse. Even if this alcohol be sold at cost, it would leave to the manufacturer a profit from the increase in weight of the animals attached to all well-organized beet-sugar factories. (The distillery utilizes the molasses, from the refuse of which potassa is obtained. From the refuse, after potassa remains a fertilizer which represents nearly all the elements that had previously been extracted from the soil. If farms are in the immediate neighborhood, this will be to them an immense advantage.) We beg to call attention to the fact that our system of taxation is such that our Government knows exactly the number of gallons distilled, hence can be known the amount of sugar the primitive grain or root contained. Consequently, after several years of experience in growing these roots, a company could be easily formed, for the reason that exact figures could be given, such as the average amount of sugar that roots contained during the four years of their growth upon a given soil, for example, and not based upon European

data, which are not, in many respects, compatible with results to be here expected, having also a tendency to mislead. The average number of tons to the acre, and the cost of growing the same, could be positively ascertained in advance. The distillery, after the beet sugar factory is started, could use the refuse molasses, as above stated. It becomes evident that thus the uncertainty of the enterprise would no longer exist. We would say, that when the farmers are willing to contract for beets for a period of years, and when the elution method, so called, is generally practiced, refuse molasses will not exist. The distillery would then be unnecessary. But we consider that under the present farmers' difficulties the distillation idea is extremely plausible. Notwithstanding, would it not be well for the friends of the beet-sugar industry, who are anti-liquor men, to realize the harm they would do if they offered any opposition to this beet-alcohol project, which is such an easy solution of so great a result?

MISCELLANEOUS SUGARS.

Various Sources of Sugar from which Nothing is to be Expected.

First.—PINITE or PINE SUGAR. It is to be found in the sap of the California pine.

Second.—ACORN SUGAR. To be found in acorns. It crystallizes.

Third.—MANNITE or MANNA SUGAR. This variety of sugar forms during the viscous fermentation of cane sugar; it crystallizes; it is to be found in the concrete juice of two kinds of ash, grown in Southern and in Eastern countries.

It is also taken from certain trees very much in the same way as the maple. This sugar contains a crystalline called mannite, which is agreeable in taste. There are 11,000 pounds of the manna imported yearly to Great Britain. After being kept for some time it produces a laxative effect upon the system. It exists in many sea-weeds. Of the various kinds of manna sugars we may mention MANNA OAK, LARCH MANNA, CEDAR MANNA (this is said to have wonderful curative properties for lung complaints), PERSIAN MANNA, TAMARISK MANNA (this latter grows in the neighborhood of Mount Sinai), ARCIN MANNA or SUGAR.

Fourth.—DULCITE. This is to be found in a crystalline substance little known, brought from Madagascar. It is also formed by the action of sodium upon milk-sugar.

Fifth.—ISODULCITE. It is formed by submitting quercitrine to the action of acids. Its crystallization

is very similar to that of cane sugar, and it is sweeter than glucose.

Sixth.—CHESTNUT SUGAR. It is made from the chestnut tree.

Seventh.—EUCALYPTUS SUGAR. Made from the sap of trees found principally in Australia, Algiers, etc.

Eighth.—LIQUORICE SUGAR. From the root of common liquorice.

Ninth.—MILK SUGAR.

Tenth.—Last of all the various GLUCOSES:

Glucose rarely, if ever, occurs in nature; it is produced by the action of acids upon cane sugar, and many erroneously confound it with the latter. The evil effects produced by it upon our community are very much greater than many suppose. As a general thing a certain amount of acid is used in its preparation, and frequently in excess, which cannot be beneficial. The crystallization, so called, is nothing more nor less than a granulation. The less we say upon this subject the better (unless a solution be given to the manner of transforming glucose into sucrose).

MALTOSE is a variety of glucose; it is produced by the action of malt upon starch paste.

FRUIT SUGAR is formed by the mixing of two glucoses in equal quantities.

MANITOSE is a glucose produced by the action of mannitic acid.

GALOTOSE is obtained by boiling milk-sugar with diluted acids.

SORBINE may be obtained from ripe mountain ash berries (also called elderberry sugar); it crystallizes, and is nearly as sweet as cane sugar.

SUGAR FROM THE PALM OR DATE.

The palm and date are used for sugar manufacture principally near Bengal, and the secondary product is

sold as jaggery, and is anything but attractive in appearance. The same may be said of the purer article from the same source known as kham. The manufacture of palm sugar, it is true, has, in India, attained a very advanced state. About 11,000 pounds are yearly extracted from that tree. The molasses is good, and may be directly eaten. The sucrose (cane sugar) crystallizes with ease. If the palm were grown over some hundred thousand times the area it now is, it might reduce considerably the price of sugar the world over. But it may be justly said that it will never be a source for sugar extraction in our Northern climes.

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